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NOTICE OF RELEASE OF '03AH3054-51 BARLEY'

Registration of '03AH3054-51' high beta-glucan barley
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Introduction

'03AH3054-51,' a two-rowed spring hulless high BG barley (Hordeum vulgare L.), was tested under the experimental number 03AH3054-51 and developed by the Agricultural Research Service-USDA, Aberdeen, ID, in cooperation with the University of Idaho Agricultural Experiment Station. 03AH3054-51 was publicly released in October 2009 due to its elevated levels of beta-glucan and increased yield potential compared to 'CDC Alamo'. 03AH3054-51 is a selection from the cross 10/Azhul//CDC Alamo made by Dr An Hang, USDA-ARS (Retired). 10 is a selection from composite cross XXXII made by Dr Tom Ramage, USDA-ARS (Retired). Azhul is a six-rowed high beta-glucan germplasm released by the ARS and Arizona Agricultural Experiment Station and is the progenitor of most high BG cultivars and germplasm. Azhul was developed by the mutation of line 76-19-7 with diethyl sulfate. 76-19-7 has the pedigree CCXXXII/'Arimont'//'Westbar'. CDC Alamo, tested as HB340, has the pedigree SB85750/Azhul. CDC Alamo is a two-rowed high BG line that has performed relatively well in Idaho and is the high BG check for ARS Aberdeen BG trials.

METHODS

Early Generation Population Development

03AH3054-51 was developed using a bulk procedure with all early generation population and line development done under irrigation at Aberdeen, ID. The cross between the two parents was made in January 1999 and F1 seed was planted in April 1999 as a single

3.1m row. F2 seed was harvested in bulk and 56g seed was planted in a 3.1-x 1.4-m plot with 35-cm row spacing. F3 and F4 generations were produced in the same manner as was the F2. Two hundred random spikes were harvested, individually threshed, and planted as F4:5 rows in the spring of 2003. Superior rows were elected based on standability, threshability, and maturity. Following evaluation for beta-glucan content from five seed, this entry was given the designation 03AH3054. In the spring of 2004 a single plot was planted and evaluated for yield, test weight, plump kernels, and beta-glucan content. It was evaluated in replicated trials in 2005 at Filer, ID. It entered replicated trials at multiple locations in 2006 at Aberdeen and Filer, ID. 03AH3054 was superior to CDC Alamo for both yield and BG content for the years 2005 and 2006, but there was enough heterogeneity in the line that 300 F8:9 spikes were selected, five seeds evaluated for BG content, and 20 seeds of each of 82 lines were increased at Christchurch, NZ over the winter of 2006-07. Based on resistance to lodging, uniform spike characteristics, threshability, and BG content, 14 F8:10 lines were selected. Included in these was line #51, which was designated 03AH3054-51. It entered replicated trials in the spring of 2007 under irrigation at Aberdeen and Filer, ID. In 2008 it was evaluated under irrigation at Aberdeen, Filer, and Tetonia, and under dryland conditions at Genesee, Fenn, and Potlatch, ID. In 2009 it was evaluated in replicated trials under irrigation at Aberdeen, Filer, and Tetonia, and under dryland conditions at Fenn, Genesee, Potlatch, Soda Springs, and Tetonia, ID.

Beta-glucan Evaluation

Approximately five grams of seed were milled by grinding through a 0.5mm screen in a laboratory cyclone mill (Udy Corporation). Enzyme measurements were performed using the commercially available kit from Megazyme International Ireland, Ltd., which provides an assay known as AACC approved method 32-23 or the McCleary method.

Eighty mg of milled flour was mixed with 200 µL 50% ethanol and 4.0 ml sodium phosphate buffer. This mixture was incubated with 50 µL lichenase enzyme and the enzymatic reaction was stopped with 5.0 ml of sodium acetate buffer. One ml of each reaction mixture was pipetted into a 1.2 ml cluster tube in a 96-well format and centrifuged. Our modified assay, in 96-well format, consisted of 25 µL of either sodium acetate buffer (blank) or beta-glucosidase enzyme mixed in respective wells with a 25 µL sample aliquot from the cluster tube. After incubation, 10µL from each test well was added to 150µL of glucose oxidase peroxidase developing reagent (GOPOD) in a second assay plate, which also included reaction blanks and glucose standards. Following a second incubation, absorbances were measured at 510 nm in a plate reader. Calculations were performed using the formula in the original McCleary method.

Agronomic Performance

Yield

Across 18 locations from 2007-09, ten rain-fed and eight irrigated, 03AH3054-51 averaged 111 percent of CDC Alamo and 66 percent of Baronesse. Across 12 locations from 2007-09, six of both irrigated and rain-fed, 03AH3054-51 averaged 72 percent of Salute. Across ten irrigated locations in 2007-09, 03AH3054-51 averaged 116 percent of CDC Alamo and 70 percent of

Baronesse. Across seven irrigated locations from 2008-09, 03AH3054-51 averaged 77 percent of Salute. Across eight rain-fed locations from 2007-09, 03Ah3054-51 averaged 103 percent of CDC Alamo and 60 percent of Baronesse. Across seven rain-fed locations from 2008-09, 03AH3054-51 averaged 64 percent of Salute.

Test weight and Plumps

Across ten locations from 2008-09, 03AH3054-51 averaged 57.9 #/Bu compared to 58.4 , 52.8, and 53.8 for CDC Alamo, Baronesse, and Salute, respectively. 03AH30554-51 and CDC Alamo were not significantly different but both were significantly greater than both Baronesse and Salute. For plump kernels, the percentage of kernels staying on a 6.5/64" sieve were measured. 03AH3054-51 averaged 59 across ten locations compared to 82, 69, and 92 for Baronesse, CDC Alamo, and Salute, respectively. Salute and Baronesse were both significantly higher than 03AH3054-51 and CDC Alamo, which were not significantly different.

Beta-glucan

Across 10 locations from 2008-09, 03AH3054-51 averaged 9.9 percent BG compared to 7.2, 3.2, and 5.8 for CDC Alamo, Baronesse, and Salute, respectively. Across six irrigated locations 03AH3054-51 averaged 9.7 percent BG compared to 7.1, 3.8, and 5.7 for CDC Alamo, Baronesse, and Salute, respectively. Across four non-irrigated locations 03AH3054-51 averaged 10.3 percent BG compared to 7.3, 3.7, and 6.0 percent for CDC Alamo, Baronesse, and Salute, respectively. Under both irrigated and non-irrigated conditions 03AH3054-51 had significantly higher levels of BG than CDC Alamo ($P<.0001$ for irrigated and $P=0.002$ for non-irrigated locations). Under both irrigated and non-irrigated conditions, CDC Alamo had significantly higher levels of BG than Salute ($P=0.001$ for irrigated and $P=0.008$ for non-irrigated).
The ultimate desire for industry is the actual yield of BG per acre. Based on the percentage BG and grain yield across 10 locations, yields of BG as pounds per acre were 325.5, 207.0, 269.2, and 184.5 for 03AH3054-51, CDC Alamo, Salute, and Baronesse, respectively.

Seed Purification and Increase

Seed of 03AH3054-51 from the original F8:10 progeny row was planted as a single 5.5m row, examined for off types and harvested in bulk in 2007. In the winter of 2007-08, two Kg of seed were increased as a single drill strip at Christchurch, NZ and approximately 200Kg of breeder seed were produced. 100 Kg of breeder seed was delivered to the University of Idaho Foundation Seed Program for production of Foundation seed in the summer of 2009.

Statistical Analyses

All statistical analyses for agronomic and beta glucan characteristics were performed using Agrobase Generation II software (Agronomix Software, 2004). Analysis of variance for yield, test weight, plump kernels, heading date, height, and lodging from ARS trials was performed across locations within years, and a combined analysis across location-years using only entries common to all trials from 2007-2009. Within year evaluations had location and genotypes as fixed factors and replications as a random factor. Analyses across years had location-years and genotypes as fixed factors and replications as random factors.

Characteristics

Agronomic and Morphological Description

For height, 03AH3054-51 is similar to CDC Alamo, as both averaged 185 (Julian days) to heading. 03AH4054-51 was significantly later than Baronesse which averaged 180 days, and Salute which averaged 179 days. Straw strength is similar to CDC Alamo, Baronesse, and Salute, as none had significant levels of lodging.

Availability

Breeder and foundation seed of 03AH3054-51 will be maintained by the Idaho Agricultural Experiment Station, Foundation Seed Program. Requests for seed should be directed to the Coordinator, Foundation Seed Program, College of Agriculture, Kimberly Research and Extension Center, 3793 N 3600 E, Kimberly, ID 83341. Small quantities are also available for research purposes from the USDA-ARS National Small Grains Collection, Aberdeen, ID. It is requested that appropriate recognition of source be given when this cultivar contributes to research or development of new germplasm or cultivar.

Acknowledgements

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References

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